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What drives bank performance in transitions economies? The impact of reforms and regulations

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Graphical Abstract

Highlights

- We analyze the effects of financial regulations and reforms on the cost efficiency of banks of 10 CEE countries for the period 2004-2009.
- Cost efficiency scores are estimated using SFA.
- Panel regressions examine the impact of regulation on bank performance using the EBRD and the Fraser indicators.
- We find that reforms on labor and business markets exert a positive impact on bank performance
- We find the effect of credit regulation banking on efficiency is positive.
- We find that better capitalized banks are more cost efficient.

Abstract

This paper investigates the effects of financial regulations and structural reforms on the cost efficiency of the banking industries of 10 Central and Eastern European (CEE) countries for the period 2004 to 2009. Cost efficiency scores are estimated using stochastic frontier analysis, whilst panel regressions examine the impact of regulation and liberalisation on bank performance using the EBRD transitional reform indicator and the Fraser economic freedom index. By considering both indexes we are able to account for the effects of progress towards more sound banking practices as well as the impact of the credit market, labor market and business sector regulatory regimes on bank efficiency. Our empirical analysis shows that structural reforms on labor and business markets exert a positive impact on bank performance. In line with the public interest view, we find the effect of credit regulation banking on cost efficiency is positive. We also find that better capitalized banks are more cost efficient.

Keywords: *Regulation; EBRD transition indicators; Fraser economic freedom index*; *bank performance; Central and Eastern European countries.*

JEL Classification*: G21, P34, P52*

1. Introduction

In the last two decades countries from Central and Eastern Europe experienced in their banking sectors dramatic changes including liberalization, consolidation and privatization coupled with a sharp increase of foreign bank participation in their economies (see EBRD Transition Report, 2010; Gwartney et al. 2010, 2012). Such reforms by changing relative prices of both inputs and outputs can have an effect on allocative efficiencies, whereas foreign entry may add to technical efficiency via the introduction of better technologies or business practices (Lehner and Schnitzer, 2008), especially when economic reform has strengthened the quality of the host country's legal environment and institutions (Poghosyan and Poghosyan, 2010). But financial deregulation may also encourage excessive credit and debt exposures that are likely to exceed the capacity of bank risk management systems and supervisory institutions. Consequently, the growth model on which many of the CEE countries relied in the pre-2007 crisis period, based on cheap funds from abroad to support credit growth, was risky and unsustainable. Against the backdrop of continuing financial market turbulence, falling lending volume compounded by exposures to distressed sovereigns, banks have found it even more difficult to remain profitable which brings into the forefront the issue of efficiency.

Our aim is to investigate the effects of regulatory reforms on CEE banks' cost efficiency during the period 2004-2009. First, we use Stochastic Frontier Analysis (SFA) to estimate cost efficiency relative to a single CEE wide cost frontier controlling for country specific characteristics. These efficiency measures are then employed in panel models to estimate the impact of regulation on bank specific cost efficiency. We use an assortment of information, such as the transition indicator of the European Bank for Reconstruction and Development (EBRD) and the Fraser economic freedom index (Gwartney et al. 2008, 2010, 2012), to

investigate the impact on cost efficiency of regulations related to credit market, as well as restrictions on labor and business markets, while controlling for other bank-specific, country and institutional-specific characteristics.[1] More precisely, we examine the effects of regulation on bank efficiency in terms of two competing hypotheses: the public interest view hypothesis and the private interest view hypothesis. Our results indicate that more liberal labor markets and business sectors seem to be associated with better bank efficiency. On the other hand we find that banking sector reforms have a negative effect on efficiency. However, our results show strong evidence that better capitalized banks are more cost efficient and this holds irrespective of whether we control for the effects of the overall regulatory environment.

The recent crisis has exposed some major gaps in the growth model for emerging economies as well as gaps in their overall framework for bank supervision and regulation. This paper contributes to the existing literature by providing new evidence on the experiences of CEE countries during the recent crisis paying particular attention to the effects of economy wide regulatory reforms for the banking industry. Such an assessment is of considerable interest for policy makers given the insolvencies of several major banks in Europe, and accompanied large withdrawal of funding from the CEE region by parent banks, thereby intensifying the contraction of credit and ensuing recessionary pressures in several CEE countries. Furthermore, an interesting question with important policy implications is to what extent economic and financial reforms are conducive to improving bank performance and therefore promoting financial stability which brings into the forefront the issue of cost efficiency not only from the point of view of bank's shareholders but from the point of view of the society. In other words is this process of "financialization" socially optimal? [2,3] What are the interactions between financialization and crises? An answer to the first question is beyond the scope of this paper. However, we provide empirical evidence that sheds some light on the second question.

We follow the methodology of Mamatzakis et al. (2013) deriving cost efficiency scores for the same CEE countries albeit with some important differences. First, we use parametric (SFA) methods allowing for measurement error while controlling for firm-specific effects in constructing individual bank efficiency measures. This is in contrast to Mamatzakis et al. (2013) who use non-parametric methods such as Data Envelopment Analysis (DEA) that are sensitive to outliers and data measurement errors. Second, Mamatzakis et al. (2013) consider a broad spectrum of the Fraser Index whereas we focus specifically on the subcomponents of the index that have the strongest influence on bank performance.

The structure of the paper is as follows. Section 2 reviews the existing literature on bank efficiency and regulations. Section 3 describes the data. Section 4 introduces the stochastic frontier model and presents the results of the fixed effects cost efficiency model. Section 5 describes the dynamic panel model and estimation results. Section 6 concludes the paper.

2. Related Literature and Hypothesis Development

According to Hughes and Mester (2015) two broad approaches are generally used in the literature to explain bank performance: structural and nonstructural. Nonstructural approaches choose different performance measures (e.g. ROE, ROA, net interest margins, Tobin's q-ratio among others), and explain these measures by an assortment of bank specific or institutional factors. Structural approaches are based on theoretical models of banking behavior such as cost minimization or profit maximization. Structural approaches rely on estimating an "efficient frontier" using linear programming methods such as Data Envelopment Analysis or parametric methods such as Stochastic Frontier Analysis and Distribution Free Approach, and treating

deviations from such frontier as a measure of inefficiency. Cost efficiency refers to the minimum cost of producing a unit of output given input prices and deviations from minimum cost can be 'technical' arising from excessive input use to produce that output or 'allocative' arising from employing the wrong input mix given their prices.

2.1 Credit market regulation and efficiency

Empirical cross-country studies have analyzed the impact of regulations on bank performance considering different financial measures (Barth et al. 2004, 2008, Djalilov and Piesse 2016), bank ratings (Pasiouras et al. 2006, Demirgüç-Kunt et al., 2008), financial and non-financial factors (Pasiouras et al. 2009, Barth et al. 2013). The evidence is not always clear cut (Barth et al. 2013) and hence the relationship between regulation and bank performance remains an empirical question.[4] Using a stochastic frontier approach, Fries and Taci (2005) examine the relative cost efficiency of banks in 15 Eastern European Countries and find that (p. 58) "progress in liberalising interest rates and credit allocation and in implementing a framework of prudential regulation and supervision, as measured by an index of the EBRD banking reform, has a non-linear association with cost efficiency." Brissimis et al. (2008) find that both banking sector reform and competition have a positive effect on cost efficiency in CEE countries. Koutsomanoli-Filippaki et al. (2009) report that non-banking reforms, as measured by the EBRD non-banking transition indicator, are associated with higher profit inefficiency whereas banking reforms are important for bank profitability. Koutsomanoli-Filippaki et al. (2009b) report a positive relationship between profit efficiency and banking reform using the EBRD index. Similarly, Delis et al. (2011) find that the ERBD banking reform index has a positive effect on bank productivity in transition economies, whereas Fang et al. (2011) report that EBRD indicators of banking reforms, privatization and corporate governance have a positive impact on bank efficiency. Finally, in a recent study, Mamatzakis et al. (2013)

using the Fraser index in a sample of 10 CEE countries for the period 2000 to 2010 find that certain aspects of credit regulation such as foreign ownership and competition and private ownership are associated with improved bank efficiency.

We summarize the contrasting effects of credit market regulation on bank efficiency in terms of two competing hypotheses. On the one hand, regulation enhances efficiency by encouraging competition and effective governance of financial institutions. Barth et al. (2006, 2013) qualify this view as the public interest view. This leads us to develop and test the following hypothesis:

H1: *Under the public interest view hypothesis we expect credit market regulation to be positively related to bank efficiency.*

Since higher levels of the credit regulation index are indicating less regulatory restrictions we will expect the index to be negatively related to cost efficiency under H1.

In contrast, from the private interest view the imposition of regulation may increase the risk-taking behavior of banks (e.g. Kim and Santomero 1988, Genotte and Pyle 1991, Van Hoose 2007, among others) or limit the abilities of banks to exploit economies of scale or scope (Barth et al. 2013) which in turn can lead to a loss in efficiency. Hence according to the private interest view bank regulation is negatively related to bank efficiency which leads to develop and test the following hypothesis:

H1a: *Under the private interest view hypothesis we expect credit market regulation to be negatively related to bank efficiency (i.e. the credit regulation index to be positively associated with cost efficiency).*

2.2 Labor market and business regulations and efficiency

The institutional settings of the labor market and business sector along with the economy's overall regulatory environment are likely to have an effect on bank efficiency and the stability of the banking system. Several studies (e.g. Blanchard and Wolfers 2000, Besley and Burgess 2004, Scarpetta and Tressel 2004) suggest that more stringent labor market regulations may induce efficiency and productivity loses for firms. The institutional environment in which banks operate is important. For instance, Barth et al. (2013) find that better institutional environments in terms of laws and regulations exert a positive and significant impact on bank operating efficiency. This leads us to formulate the following testable hypothesis:

H2: *Labor market rigidities are expected to be negatively related to cost efficiency.*
Since higher levels of the index of labor market reforms are indicating a higher level of economic freedom (less regulatory restrictions) we will expect the index to be positively related to cost efficiency.

Business market regulation refers to regulations and barriers that prevent entry and reduce competition in the market and may affect bank efficiency through spillover effects. A favorable business environment, with protection of intellectual property, secure property rights, and low entry barriers would stimulate business activity and firm creation (Klapper et al. 2006) whereas weak property rights discourage firms from reinvesting their profits and consequently adversely affect firm's investment decisions and financing (Johnson et al. 2002). According to Johnson et al. (2002: p.1354-1355), "insecure property rights mean firms have limited incentive to invest and therefore little demand for external finance". This in turn has an adverse impact on credit market development and therefore on bank performance which lead us to formulate the following testable hypothesis:

H3: *Lower regulatory restrictions in the business sector have a positive impact on bank efficiency.*

3. Data and Descriptive Statistics

The data used in this paper was extracted from the IBCA-Bankscope database for the period 2004 to 2009. It comprises samples of 268 commercial banks, and after removing errors and inconsistencies, we end up with an unbalanced panel of 1,611 bank-year observations. Table 1 summarizes our data showing similarities but also some notable differences across CEE countries. For example, banks tend to be much larger on average in the Czech Republic where also loan loss provisions as a share of total loans are much higher. Competitiveness in the sector (Hirschman-Herfindahl index) ranges from 52% in Latvia to 90% in Estonia. Not surprisingly, the more developed countries in terms of GDP per capita also have the highest level of financial development proxied by private sector credit. Most countries score highly in the overall index of credit regulations (CR). With respect to the components of the CR index a similar picture emerges.

INSERT TABLE 1 HERE

Table 2 shows improvements in banking and economic reform over time. This is especially true for the CR-Own and the CR-Comp indices reflecting lower state ownership and increased presence of foreign banks as a result of the privatisation programmes and further reforms to prepare for EU accession. On the other hand, labor regulations (LR) have improved at a slower rate while business regulations (BR) remained roughly stable. There is a notable drop in some of these indices in 2009 reflecting the regulatory response to GFC.

INSERT TABLE 2 HERE

4. Stochastic Frontier Analysis and the Determinants of Bank Efficiency

We adopt a two stage estimation procedure. In Stage 1 we use stochastic frontier analysis methods to construct measures of bank cost efficiency. And in Stage 2 we analyze the determinants of cost efficiency employing panel models, both static fixed effects models and also dynamic panel models.[5] The main advantage of measuring bank performance opting for stochastic frontier analysis is that it provides parametric estimates of efficiency at bank level that are subject to statistical hypothesis testing (see Pastor and Serrano, 2005, Meeusen and Van den Broeck, 1977). Setting the underlying framework of our methodology, every bank in our sample attempts to minimize costs so as to reach the optimum level of minimum cost.

4.1.1 Measuring Cost Efficiency

The following parametric translog specification of the cost function is chosen due to its flexibility:[6]

$$\ln C_i = \alpha_0 + \sum_i a_i \ln P_i + \sum_i \beta_i \ln Y_i + \tfrac{1}{2} \sum_i \sum_j a_{ij} \ln P_i \ln Pj + \tfrac{1}{2} \sum_i \sum_j \beta_{ij} \ln Y_i \ln Y_j +$$

$$\sum_i \sum_j \delta_{ij} \ln P_i \ln Y_j + \sum_i \varphi_i \ln N_i + \tfrac{1}{2} \sum_i \sum_j \varphi_{ij} \ln N_i \ln N_j + \sum_i \sum_j \xi_{ij} \ln P_i \ln N_j$$

$$+ \sum_i \sum_j \zeta_{ij} \ln Y_i \ln N_j + \theta_1 t + \tfrac{1}{2} \theta_2 t^2 \sum_i \mu_i t \ln P_i + \sum_i \kappa_i t \ln Y_i + + \sum_i \nu_i t \ln N_i + kD_i + \sum_i \xi_i Z_i$$

$$+ u_i + v_i \qquad (1)$$

Where C_i denotes observed total cost for bank i, P_i is a vector of input prices, Y_i is a vector of outputs, N_i is a vector of quasi-fixed inputs, Z_i is a vector of control variables, and for simplicity we have dropped the time subscript. Total cost is the sum of overheads (personnel and administrative expenses), interest, fees and commission expenses. The two outputs are: loans (*Y1*) and other earning assets (*Y2*) which include government securities, bonds, equity investments, CDs. The vector P_i of input prices contains the price of labor measured as the

ratio of personnel expenses to total assets (*P1*) and the price of borrowed fund measured as total interest expenses over total deposits and short-term funding (*P2*). The special characteristic of equation (1) refers to the error term that consists of two parts, v_{it} accounts essentially for the classical error term that follows a normal distribution whilst u_{it} represents the (one-sided) inefficiency term as bank *i* could incur higher costs when benchmarked against its best performing peers in the sample. Given that inefficiency cannot take negative values this term follows the half-normal distribution. We also include two fixed inputs, namely physical capital (*N1*) and equity (*N2*). Equity inclusion is of some importance as it represents valuable funding and as such could impact upon cost structure (Berger and Mester, 1997). Moreover, exclusion of equity would result in biased estimations as banks with higher equity capital could display risk aversion in terms of behaviour compared to banks with lower level of equity.[7] The control variables include GDP growth per capita (*Z1*) to capture cross-country heterogeneity in terms of the underlying macroeconomic framework and the inflation rate (*Z2*) as a general financial stability index.

Lastly, we apply linear homogeneity and symmetry in quadratic terms in line with duality theory. Country and time effects are also captured.[8] We opt for maximum likelihood estimation of the stochastic frontier model where the parameters of error variance are $\sigma_{\varepsilon}^2 = \sigma_u^2 + \sigma_v^2$ and $\gamma = \sigma_u^2 / \sigma_{\varepsilon}^2$.

4.1.2 Cost Efficiency Estimates

Table 3 reports cost efficiency estimates obtained from equation (1) for each country for the period 2004 to 2009. According to the SFA results average overall cost efficiency is 0.794 indicating that the average CEE bank could reduce its costs by 20.6% to match the performance of its most efficient peers. Our results corroborate previous studies for transition economies (e.g. Kasman and Yildirim 2006, Yildirim and Philippatos 2007, Mamatzakis et al. 2008).

Table 3 also shows that average bank cost efficiency across the CEE region has increased from 2004 (date in which most CEE countries joined the EU) to 2009. Hence the new member states appear to have made significant performance improvements in their banking systems after joining the EU, and this holds in spite of the adverse effects of the global financial crisis.

INSERT TABLE 3 HERE

4.2 Determinants of Cost Efficiency

Next we employ cost efficiency scores, as derived from the sample of CEE countries that share a common frontier, to estimate the impact of the economic environment on bank performance, using as control variables bank specific characteristics and the structure of the national financial systems. Specifically, we adopt panel data methods to estimate a fixed effects model specified as:

$$Eff_{it} = \mu_i + \sum_i \beta_i ZB_{it} + \sum_i \gamma_i X_{it} + \sum_i \delta_i reg_{it} + e_{it} \qquad (2)$$

Where Eff_{it} denotes bank cost efficiency, ZB_{it} is a vector of bank specific characteristics, X_{it} accounts for the level of economic development and financial structure, whilst reg_{it} is a vector of regulation and reform indicators. Fixed effects (μ_i) capture unobserved time-invariant bank specific heterogeneity which may be correlated with the regulation indexes or with observed bank specific variables. Time dummies and country dummies may also be introduced to capture structural changes or other time-varying unobserved effects which may be common across banks and account for differences across countries, respectively.[9]

We control for bank characteristics using (log) total assets as a proxy for economies of scale, this can lead to either higher or lower costs for the bank (Fries and Taci, 2005); the ratio of loans to assets as a proxy for asset utilisation which is expected to have a positive effect on

cost efficiency; the ratio of equity over total assets as a proxy for capital adequacy, which is also expected to have a positive effect on efficiency as better capitalised banks have stronger incentives in improving their performance and minimising costs. We also include loan loss provisions, accounting for the quality of credit portfolio, as a determinant of cost efficiency. In empirical studies there is mixed evidence on the sign of loan loss provisions as their impact on bank performance in the short term may be different compared to the long term. To control for financial structure, we consider the ratio of domestic credit to the private sector over GDP (DCPS) capturing the level of development of the financial sector. We also employ the Hirschman-Herfindahl index (HHI) as a proxy for the level of market concentration as well as the interest rate spread (SPR) also a measure of market power. Finally, as a control for the general macroeconomic environment, we consider real GDP per capita in purchasing power parity (PPP) terms (Karas et al 2010, Kosac et al 2009 and Poghosyan and Poghosyan 2010). We also include inflation to capture financial stability from a macroeconomic perspective (Havrylchyk 2006, Bonin et al. 2005, and Yildirim and Philippatos 2007).

The reform and regulation variables include the EBRD indicators representing the level of progress of transition in East Europe and elsewhere (see table A2 in Appendix for detailed descriptions); and in particular, the EBRD sub-components capturing competition policy (Compebrd), banking reform (Bankebrd), and securities market reform (Secebrd).[10] We also consider the impact of credit (CR), labor (LR) and business regulations (BR) on bank efficiency using the regulation indexes provided by the Fraser Index of Economic Freedom (Gwartney et al. 2010).[11] Again we pay particular attention to the sub-components of the credit regulation index; namely, bank ownership (CR-Own), foreign bank competition (CR-Comp), private sector credit (CR-Prs), and interest rate controls (CR-Nir) (see Table A1 in Appendix for more detailed description).[12] Based on the private interest view and according to our H1a hypothesis

more stringent regulations relative to foreign competition (CR-Comp) and private sector credit (CR-Prs) as well as greater government ownership are expected to be associated with lower bank efficiency, whereas progress with banking reforms and interest rate liberalization (Bankebrd) and the lifting of interest rate controls (CR-Nir) are expected to be positively related to bank efficiency.

4.3 Cost Efficiency: Fixed effects results

Table 4 shows results from the baseline model that excludes regulation and reform variables. We find that better capitalised banks are more cost efficient. This result is in line with other studies that find a positive relationship between capital adequacy and efficiency (Berger and Mester 1997, Yildirim and Philippatos, 2007, Delis et al. 2011) and is also robust to controlling for country-specific factors (see column 2). However, the effect of size (log Assets) on cost efficiency is negative. A possible explanation for this finding may be due to the presence of large state banks in our sample that are highly inefficient (EBRD, 2010). This result is contradiction with Triki et al. (2017) who find a positive relationship between bank size and bank efficiency. The effect of asset utilisation (loans/assets) on cost efficiency is also negative albeit statistically insignificant when controlling for country-specific factors. The negative association between asset utilisation and cost efficiency may reflect greater pressure in containing costs of credit origination and monitoring for larger loan portfolios. We find that both measures of market power, SPR and HHI are associated with more cost efficient intermediation operations. The association of market concentration with lower costs suggests that "higher concentration reflects competitive selection and consolidation through survival of more efficient banks" Fries and Taci (2005). This finding is also in line with other studies that find a positive relationship between cost efficiency and concentration (e.g. Yildirim and Philippatos, 2007) but in contradiction with Delis et al. (2011) who report a negative relationship. The effect of GDP per capita is negative indicating the level economic

development is not necessarily an indicator of bank cost efficiency at least in the CEE region. This finding is in line with evidence reported by Mamatzakis et al. (2013).

INSERT TABLE 4 HERE

4.3.1 The Impact of Fraser Index and EBRD Regulations on Cost Efficiency

We consider first the impact of credit regulation (CR), labor market regulation (LR) and business regulation (BR) components of the Fraser index on cost efficiency. Table 5 shows that the three regulation variables are significant at the 1% level. Credit regulation is negatively associated with cost efficiency rendering support to the public interest view hypothesis (H1). We also find support for the H2 and H3 hypotheses, that less stringent labor market regulation and business sector regulation, respectively, have a positive impact on cost efficiency. Mamatzakis et al. (2013) find that credit regulation and business regulation are not statistically significant while labour market regulation has a positive effect on efficiency. Table 5 also shows that the effects of capitalisation and size reported in Table 4 are robust to the inclusion of regulation variables. We find that financial deepening (DCPS) has a negative effect on cost efficiency. This finding may reflect the risks associated with excessive credit growth observed in several CEE banking systems in the lead up to the global financial crisis. Finally, inflation is significant at the 1% and positively related to cost efficiency. High inflation affects bank behaviour and induces banks to compete through excessive branch networks (Kasman and Yildirim, 2006).

INSERT TABLE 5 HERE

We proceed next to examine the effect of credit regulation on cost efficiency in more detail by considering the main sub-components of the Fraser credit regulation index such as CR-Comp, CR-Nir, and CR-PrS .[13] The results of table 6 show that only the CR-PrS variable is significant

on cost efficiency. The negative effect is in line with our previous findings (Table 5). A possible explanation of the negative relationship between the CR-Prs variable and cost efficiency is that lending to the private sector may entail costly monitoring and screening coupled with the risks of excessive credit growth on financial stability. Most of the control variables remain consistent with the results from the earlier models.

INSERT TABLE 6 HERE

We turn next to examine the effect of EBRD financial regulation indexes on cost efficiency. These results are presented in Table 7. We find that banking reform (Bankebrd) has a negative and significant effect on cost efficiency in the last column that also considers the other two financial indicators. The effect of capitalization on cost efficiency remain robust throughout our analysis while for the first time we find loan loss provisions to have a significant and positive effect on cost efficiency. This result is in contradiction with other studies that find a negative relationship between credit risk and efficiency (Yildirim and Philippatos 2007, Delis et al. 2011) but in line with Koutsomanoli-Filippaki et al. (2009a) and Koutsomanoli-Filippaki, et al. (2009b).

INSERT TABLE 7 HERE

5. Dynamic Panel Analysis

One of the frequent criticisms of models such as equation (2) refers to the endogeneity of some of the right hand variables, in particular bank specific characteristics, especially in situations where unobserved heterogeneity may be changing over time. As a way of addressing this criticism and assess the robustness of our findings we proceed to estimate both a dynamic version of the fixed effects panel model and a panel vector autoregressive model.

5.1 *Dynamic Fixed Effects Model*

A common criticism of the fixed effects panel model is the static nature of the underlying relationships among the variables, when one would expect that such types of relationships evolve over time. This is in addition to endogeneity issues that arise in this context. We employ the Arelano and Bover (1995) dynamic panel data model that uses an instrumental variables methodology based on the GMM estimator to resolve the issue of endogeneity in a dynamic context. The model takes the following general form:

$$Eff_{it} = \mu_{it} + \alpha Eff_{it-1} + \sum_i \beta_i Z_{it} + \sum_i \gamma_i REG_{it} + e_{it} \qquad (3)$$

Where Eff_{it} denotes cost efficiency of bank i in year t, Z_{it} accounts for bank or country specific control variables and REG_{it} denotes various EBRD or Fraser reform indexes.

Table 8 reports cost efficiency estimates of the dynamic panel model using as determinants Fraser reform (column 1) and EBRD reform indicators (column 2). Efficiency shows some persistence. The coefficient of lagged efficiency is positive and significant with a value well below unity, a finding consistent with Delis et al. (2011).[14] As before, we find that better capitalized banks are more efficient while size retains a negative association with cost efficiency and the same applies for financial deepening. Similarly, less stringent labor and business regulations have a positive effect on efficiency providing further support for hypotheses H2 and H3. However, we find that credit regulation has no longer an effect on cost efficiency, suggesting that the forces that underpin the two competing hypotheses, H1 and H1a, may be offsetting each other. The EBRD index of market reform capturing competition policy (Compebrd) is significant at the 10% level whereas bank reforms (Bankebrd) and securities markets reforms (Secebrd) are not significant. [15]

INSERT TABLE 8 HERE

5.2 *Panel-VAR analysis*

We consider next a panel vector autoregressive (PVAR) model in which all variables are jointly determined. This is used to address endogeneity issues as well as model the dynamic and cross-sectional interdependencies that may exist between our bank performance measure and the EBRD/Fraser indexes. This is a major advantage of PVAR over a univariate panel regression model specification. An added feature of the PVAR model is that it allows investigating through impulse response analysis the transmission of shocks, such as for example those during the GFC across banks in the CEE region. Similarly, impulse response analysis is useful from a policy perspective to investigate the response to reform/regulation changes on bank performance. The PVAR model is sufficiently flexible to pick up any structural breaks through the responses of variables to various shocks. The model can take the following general form:

$$W_{it} = \alpha_i + \beta W_{i,t-1} + \gamma X_{i,t-1} + e_{it}, \quad i = 1,\ldots, \mathrm{N}, \; t = 1,\ldots, \mathrm{T}. \qquad (4)$$

Where W_{it} is a stacked vector of variables comprising bank efficiency (Eff) and either the Fraser reform indexes covering credit regulation (CR), labor regulation (LR) and business regulation (BR); or alternatively, the three broad aspects of transition EBRD indexes comprising competition policy (Compebrd), financial institutions, banking reform and interest rate liberalization (Bankebrd), and securities markets and non-bank financial institutions (Secebrd). Note that PVARs have the same structure as VAR models where all variables are assumed to be endogenous and interdependent, but add a cross sectional dimension to the specification of the model. This is important since the dynamic structure of (4) above implies that such specifications capture the dynamic interdependencies among the individual units (*i*). The coefficient matrix β in (4) has dimension 4x4 matrix, whilst α_i captures fixed effects, X controls for other bank or country specific effects, and $e_{i,t}$ denote i.i.d. residuals (Love and Zicchino, 2006). As required we apply forward mean-differencing to our variables with the

Helmert procedure (Arellano and Bover, 1995). Lastly, Monte Carlo simulations provide the standard errors for the impulse response functions (IRFs thereafter).

Prior to estimating the panel VAR it is crucial to select the lag order. Following Lutkepohl (2006) we employ the Arellano-Bond GMM estimator for different lags j=1, 2 and 3.[16] Note that we opt for up to three lags so as to examine any underlying autocorrelation. We find that choosing one lag is sufficient for our purposes. We also test for normality with the Sahpiro-Francia W-test without observing any violations.[17]

Figure 1 shows the impulse response functions (IRF). In Figure 1 the plot in the first row depicts the response of bank efficiency (EFF) to a shock in credit regulation (CR), labor market regulation (LR) and business regulation (BR), respectively, measured in standard deviations terms. It is clear from the first row that the response of bank efficiency to credit regulation is positive for the first six years, with a hike after one period, whereas it dies out thereafter. This is an interesting result as it highlights that credit regulation improves bank performance, a result that one would expect to hold in particular in periods of financial crisis as prudent regulation leads to a safe and sound financial system. Our result is line with other cross-country studies that find a positive relationship between tighter capital regulation and bank efficiency (e.g. Barth et al. 2004, Barth et al. 2013, Pasiouras et al. 2009 find that stricter capital requirements have a positive impact on cost efficiency).

On the other hand, labor market regulation asserts a negative impact on bank efficiency. This result suggests that banks could improve their performance in a more liberal labor market environment. Lastly, the impact of business regulation is positive on bank efficiency but only in the very short run and convergences towards zero thereafter. Our results are in line with

Demirguc-Kunt et al. (2004) and Barth et al. (2006), Kondeas et al. (2008) who emphasizes the positive impact of bank specific reform efforts on bank efficiency. Moreover, in terms of magnitude, it appears that credit regulation have the dominant effect on efficiency.

Our panel VAR analysis encompasses solving a complex identification problem. A standard approach (see Love and Zicchino, 2006; Arias and Escudero, 2007) is to order the variable in the VAR following some preferences of which variables might be more exogenous than others. In that case the ordering should be to rank first exogenous variables followed by more endogenous ones in a sequential order (see Love and Zicchino, 2006). This is the standard identification strategy implicit in the Choleski decomposition, which induces a recursive orthogonal structure on the structure of the shocks. To this end, as regulation is outside the control of the banks, we consider it as the most exogenous variable. Thus, performance measured by the efficiency that comes from cost minimization at bank level, is more endogenous than regulation. The reverse causation has been also tested, providing similar results.[18]

INSERT FIGURE 1 HERE

In Table 9 (Panel A) we report the variance decomposition (VDC). The findings are consistent with our previous results from the impulse response functions providing additional evidence of the importance of the relationship between reforms and variation in bank efficiency. We find 7.2% of the variation of cost efficiency is explained by labor market regulation, whilst only 0.4% is explained by business regulation. Efficiency also explains part of forecast error variance of regulation, in particular credit regulation and business regulation. Furthermore, our results (Panel B) show that EBRD reforms play a role in the variance decomposition of bank

efficiency with 15% and 10% of bank efficiency explained by shocks in banking reform and competition reform, respectively. Thus, a feedback channel from bank performance to regulation, which is highly associated to the environment that banks operate, also exists. Overall, the VDC analysis confirms the importance of bank specific regulation to bank cost efficiency as credit regulation plays the dominant role, whilst evidence of reverse causation is also present.

INSERT TABLE 9 HERE

Figure 2 presents the IRFs from the 4x4 panel VAR of cost efficiency and the three EBRD reform indexes. Interestingly, one standard deviation shocks in EBRD reform indexes assert a negative impact on bank efficiency. This result is in line with the EBRD (2010) report that reforms have a negative impact on performance in the short run, and it is only in the long run that the economy could reap the fruits of structural changes towards more competitive forms of markets.[19] Note, however, that in terms of magnitude, the EBRD reform indexes do not have a strong negative impact on bank performance.

INSERT FIGURE 2 HERE

6. Conclusion

This paper presents new evidence on the importance of reforms and regulations for the banking industry using the EBRD transitional reform indicator and the Fraser economic freedom index. Favourable economic conditions in the labor and business sectors seem to improve cost efficiency while banking reform appears to have a negative effect. Our empirical analysis shows that reforms in the credit market such as those allowing greater presence of privately owned banks, foreign banks, and the removal of interest rate controls have no impact on bank efficiency while a higher share of private sector borrowing has a negative effect. One possible

explanation, as alluded in the Gwartney et al. (2012: p.8) report, is that these indicators may not be as effective in capturing constraints on economic freedom and consequently they may not fully reveal the true impact of economic freedom on bank performance. The effect of bank regulation on cost efficiency is positive providing support to the public interest view hypothesis.

Dynamic panel analysis confirms the findings of our static fixed effects models. It shows that labor market reforms, less stringent business regulations and competition policy reforms have a positive effect on bank efficiency. We find that bank size has a negative effect on cost efficiency. More importantly, we find that better-capitalized banks are more efficient. The relationship between capital and bank performance is the subject of ongoing research, particularly so in recent years mainly as a result of new regulations (e.g. Basel III capital requirements) in response to the Global Financial Crisis. We provide new evidence which clearly demonstrates that better capitalized banks are more cost efficient. And this is true irrespective of the stringency or otherwise of the regulatory environment captured by the EBRD transitional reform indicators and Fraser economic freedom indexes used in our empirical analysis. Given the opposing views and theoretical predictions on this subject, this is an important finding for more informed policy decision making. It will be of interest in future research to test further the relationship between capital requirements relative to the Basle Accords and cost efficiency and more generally the question whether it is optimal for banks to hold equity well in excess of capital requirements. Also another interesting issue as suggested by Lagoarde-Segot (2015) is to examine the societal and economic implications of the ongoing technological and legal changes in the financial system for the CEE countries.

References

Arias, O. and Escudero, W.S. (2007). Assessing trends in informality in Argentina: a cohorts panel VAR approach. Mimeo, World Bank.

Arellano, M., Bover O, 1995. Another look at the instrumental-variable estimation of error-components models. Journal of Econometrics, 68, pp. 29-52.

Barth, J., Caprio, G., and R. Levine, 2004. Bank regulation and supervision: what works best?. Journal of Financial Intermediation 13(2), pp. 205-248.

Barth, J, Caprio, G., R.Levine, R., 2006. *Rethinking Bank Regulation Till Angels Govern*.Cambridge University Press, New York, NY.

Barth, J., Caprio, and R. Levine, 2008. Bank regulations are changing: For better or worse? Comparative Economic Studies, 50, pp. 537-563.

Barth, J., Chen L., Ma Y., Seade J. and F. Song 2013, Do Bank Regulation, Supervision and Monitoring Enhance or Impede Bank Efficiency? Journal of Banking and Finance, 37, pp. 2879-2892.

Berger, A. N., Mester, L., 1997. Inside the black box: what explains differences in the efficiencies of financial institutions?, Journal of Banking and Finance, 21 (7), pp. 895-947.

Besley T., Burgess R., 2004. Can Labor Regulation Hinder Economic Performance? Evidence from India, Quarterly Journal of Economics, vol. 119(1), pp. 91-134.

Blanchard, O., Wolfers J. 2000. The role of shocks and institutions in the rise of European unemployment: Aggregate evidence, Economic Journal, vol. 110(462), pp. 1-33.

Bonin, J., Hassan, I., Wachtel, P., 2005. Bank performance efficiency and ownership in transition countries. Journal of Banking and Finance 29, pp. 31-53.

Brissimis S., Delis M., and I. Papanikolaou, 2008. Exploring the nexus between banking sector reform and performance: Evidence from newly acceded EU countries, Journal of Banking and Finance, vol. 32, pp. 2674–2683.

Buchanan, B.G. 2016. The way we live now: Financialization and securitization. Res. Int. Business Finance, http://dx.doi.org/10.1016/j.ribaf.2015.11.019.

Delis, M. Papanikolaou N., 2009. Determinants of bank efficiency: evidence from a semi-parametric methodology, Managerial Finance, Vol. 35(3), pp. 260 - 275.

Delis, M., Molyneux P., Pasiouras F., 2011. Regulations and Productivity Growth in Banking: Evidence from Transition Economies, Journal of Money, Credit and Banking, 43(4), pp. 735-764.

Demirguc-Kunt, A. Laeven, L., Levine, R., 2004. Regulations, Market Structure, Institutions, and the Cost of Financial Intermediation, Journal of Money, Credit and Banking 36(3), pp. 593-622.

Demirguc-Kunt, A., Detragiache, E., Tressel, T., 2008. Banking on the Principles: Compliance with Basel Core Principles and Bank Soundness, Journal of Financial Intermediation 17, pp. 511-542.

Djalilov K, Piesse J., 2016. Determinants of bank profitability in transition countries: What matters most?, Research in International Business and Finance, 38, pp. 69–82.

EBRD 2010 Recovery and Reform, Transition Report.

Fang, Y., Hasan I., Marton K., 2011. Bank efficiency in South-Eastern Europe, Economics of Transition 19(3), pp. 495-520.

Fries, S., Taci, A., 2005. Cost efficiency of banks in transition: evidence from 289 banks in 15 post-communist countries. Journal of Banking and Finance 29, pp. 55-81.

Fries, S., Neven D., Seabright P., and A. Taci (2006), Market Entry, Privatization and Bank Performance in Transition, Economics of Transition, 14, pp. 579–610.

Gennotte, Gerard, Pyle, David, 1991. Capital controls and bank risk. Journal of Banking and Finance 15, pp. 805–824.

Gwartney J.D., Hall J.C., Lawson R., 2008. Economic Freedom of the World: 2008 Annual Report. Vancouver, BC: The Fraser Institute. Data retrieved from www.freetheworld.com.

Gwartney J.D., Hall J.C., Lawson R., 2010. Economic Freedom of the World: 2010 Annual Report. Vancouver, BC: The Fraser Institute. Data retrieved from www.freetheworld.com.

GwartneyJ.D., Hall J.C., Lawson R., 2012. Economic Freedom of the World: 2012 Annual Report. Vancouver, BC: The Fraser Institute. Data retrieved from www.freetheworld.com.

Havrylchyk, O., 2006. Efficiency in the Polish banking industry: foreign versus domestic banks, Journal of Banking and Finance 30, 1975-1996.

Hughes J., L. Mester, 2015. Measuring the Performance of Banks: Theory, Practice, Evidence and Some Policy Implications, in the Oxford Handbook of Banking, Second Edition, Oxford University Press, pp.247-270.

Johnson S., Mcmillan J. and C. Woodruff 2002. Property Rights and Finance, The American Economic Review, vol. 92(5), December, pp. 1335-1356.

Karas, A., Schoors K., Weill L., 2010. Are private banks more efficient than public banks? Evidence from Russia, Economics of Transition 18(1), pp. 209-244.

Kasman A., Yildirim C., 2006. Cost and profit efficiencies in transition banking: the case of new EU members, Applied Economics 38, pp. 1079-1090.

Kim, D., Santomero A. 1988. Risk in Banking and Capital Regulation, Journal of Finance, 43, pp. 1219-1233.
Klapper L, Laeven L., and R.Rajan, 2006. Entry regulation as a barrier to entrepreneurship,Journal of Financial Economics, 82, pp. 591-629.

Kondeas, A., Caudill, S., Cropper, D., Raymond J, 2008. Deregulation and Productivity Changes in Banking: Evidence from European Unification. Applied Financial Economics Letters 4, pp. 193-197

Kosak M, Zajc P., Zoric J., 2009. Bank Efficiency differences in the new EU member states. Baltic Journal of Economics 9(2), pp. 98-100

Koutsomanoli-Filippaki A. Mamatzakis E. and C. Staikouras 2009. Structural reforms and banking efficiency in the new EU States, Journal of Policy Modelling, vol.31(1), pp. 17-21.

Koutsomanoli-Filippaki A., Margaritis D., and C. Staikouras 2009(a). Efficiency and productivity growth in the banking industry of Central and Eastern Europe, Journal of Banking & Finance, 33, pp. 557–567.

Koutsomanoli-Filippaki A., Margaritis D., and C. Staikouras 2009(b). Profit efficiency under a directional technology distance function approach, Managerial Finance, Vol. 35 No. 3, pp. 276-296.

Lagoarde-Segot Th. 2016. Financialization: Towards a new research agenda, International Review of Financial Analysis, http://dx.doi.org/10.1016/j.irfa.2016.03.007.

Lehner, M., Schnitzer, M. 2008. Entry of foreign banks and their impact on host countries, Journal of Comparative Economics, 36(3), pp. 430–452.

Love, I., Zicchino L., 2006. Financial Development and Dynamic Investment Behavior: Evidence from Panel VAR. The Quarterly Review of Economics and Finance 46, pp. 190–210.

Lütkepohl, H. 2006. New Introduction to Multiple Time Series Analysis. Springer, Berlin.

Mamatzakis, E., Staikouras C., and A. Koutsomanoli-Filippaki 2008. Bank efficiency in the new European Union member states: Is there convergence?, International Review of Financial Analysis, 17, pp. 1156–1172.

Mamatzakis, E, Kalyvas A. and J. Piesse 2013. Does regulation in Credit, Labour and Business matter for bank performance in the EU-10 Economies? International Journal of the Economics of Business, vol. 20(3), pp. 341-385.

Meeusen W., J. Van den Broeck 1997. Efficiency estimation from Cobb-Douglas Production Function with Composed Error, International Economic Review, vol. 8, pp. 435-444.

Pasiouras, F., Ch. Gaganis, and C. Zopounidis. 2006. The Impact of Bank Regulations, Supervision, Market Structure, and Bank Characteristics on Individual Bank Ratings: A Cross-Country Analysis, Review of Quantitative Finance and Accounting, 27, pp. 403–38.

Pasiouras, F., Tanna, S., Zopounidis, C., 2009. The impact of banking regulations on banks' cost and profit efficiency: Cross-country evidence, International Review of Financial Analysis 18, pp. 294-302.

Pastor J. L. Serrano 2005. Efficiency, endogenous and exogenous credit risk in the banking systems of the Euro area, Applied Financial Economics, vol. 15(9), pp. 631-649.

Poghosyan, T., A. Poghosyan 2010. Foreign bank entry, bank efficiency and market power in Central and Eastern European Countries, Economics of Transition 18(3), pp. 571-598.

Scarpetta S., T. Tressel 2004. Boosting Productivity via Innovation and Adoption of New Technologies: Any Role for Labor Market Institutions?, World Bank Research Working Paper 3273. Washington, DC: World Bank.

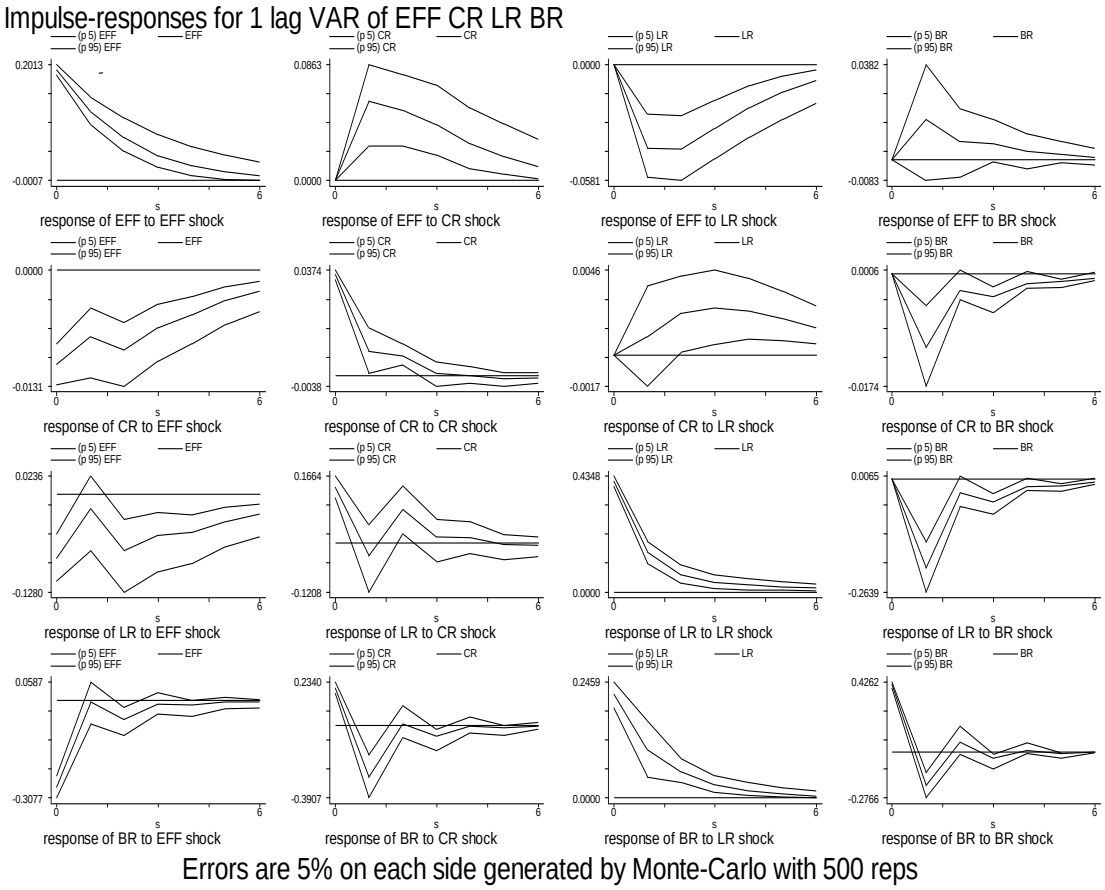
Sokol, M. (2015). Financialisation, financial chains and uneven geographical development: Towards a research agenda. Res. Int. Business Finance, http://dx.doi.org/10.1016/j.ribaf.2015.11.007.

Triki Th., Kouki I., Ben Dhaoua M., and P. Calice (2017). Bank regulation and efficiency: What works for Africa? Res. Int. Business Finance, 39, pp. 183-205.

Van Hoose, D. 2007. Theories of Bank Behaviour under Capital Regulation, Journal of Banking and Finance, 31, 3680–97.

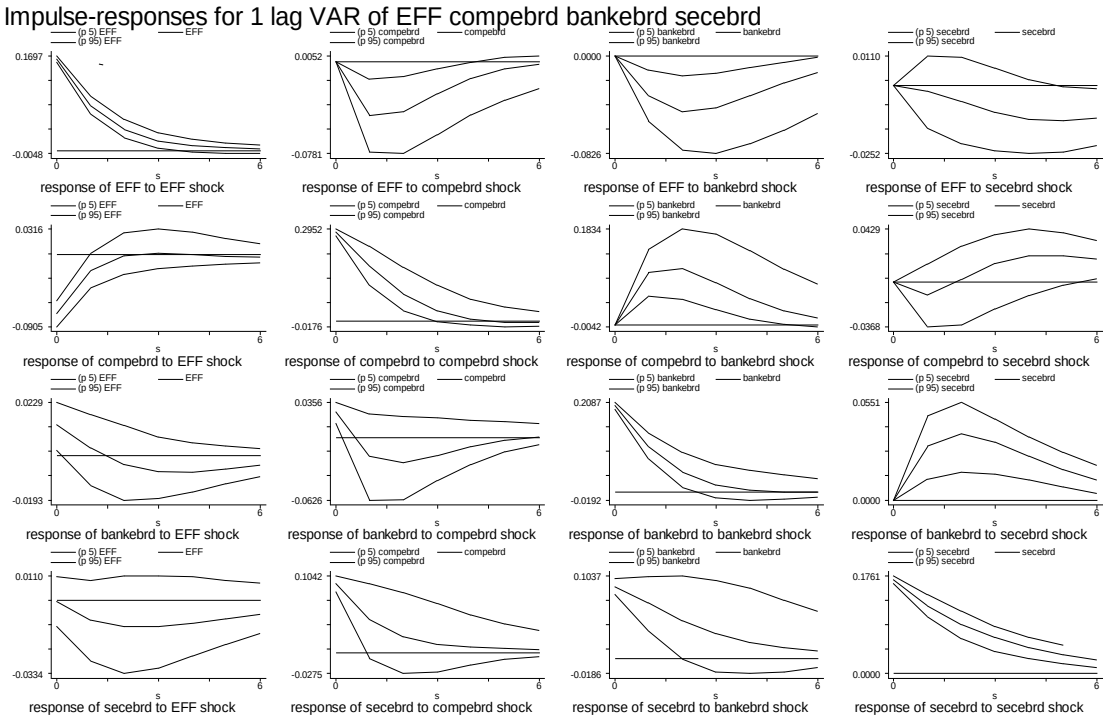
Yildirim, H.S., G. Philippatos, 2007. Efficiency of banks: recent evidence from the transition economies of Europe, 1993–2000, The European Journal of Finance 13(2), 123–143.

Figure 1: Impulse Response Function (IRF) for one lag of EFF, CR, LR and BR



Note: EFF: efficiency; CR: composite credit regulation index, LR: composite labour regulation index, BR: composite business regulations index.

Figure 2: Impulse Response Function (IRF) for one lag of EFF, Compebrd, Bankebrd, and Secebrd



Note: EFF: efficiency, Compebrd: competition policy, Bankebrd: banking reform and interest rate liberalization, and Secebrd: securities markets and non-bank financial institutions, respectively.

.

Table 1: Descriptive Statistics (2004-2009)

Country	lnP_1	lnP_2	lnY_1	lnY_2	TA	E/A	LLP/L	L/A	DCPS	SPR	HHI	GDPcppp	INFL	CR	CROwn	CRComp	CRPrS	CRnir	LR	BR
Bulgaria	0.0118	0.0375	13.1744	11.9846	920.16	0.16	0.05	0.52	40.49	16.58	0.64	9.348	6.84	0.89	0.90	0.83	0.99	0.97	0.65	0.53
Czech Rep.	0.0067	0.0815	14.6693	14.2881	6.056.91	0.09	0.13	0.46	51.28	4.7	0.7	19.275	2.20	0.86	0.85	0.78	0.87	1.00	0.71	0.56
Estonia	0.0174	0.0672	12.9661	11.2281	2.243.10	0.11	0.02	0.61	58.38	4.42	0.9	13.603	5.93	0.94	0.98	0.81	1.00	0.98	0.55	0.70
Hungary	0.0193	0.0529	14.3909	12.6196	4.634.17	0.11	0.02	0.62	48.03	2.94	0.71	15.720	4.87	0.83	0.91	0.75	0.66	0.99	0.66	0.63
Latvia	0.0145	0.0257	12.3786	12.2651	1.057.68	0.14	0.04	0.45	55.69	6.09	0.52	11.716	10.15	0.90	1.00	0.72	0.94	0.95	0.60	0.60
Lithuania	0.0126	0.0288	13.6913	12.3523	1.773.92	0.11	0.03	0.58	35.33	4.48	0.8	12.824	5.09	0.88	0.84	0.82	0.90	0.96	0.52	0.61
Poland	0.0152	0.0380	14.1266	13.8026	4.645.65	0.14	0.01	0.57	34.67	4.93	0.64	13.805	2.65	0.84	0.78	0.87	0.78	1.00	0.62	0.50
Romania	0.0236	0.0513	13.3715	11.9916	2.291.56	0.15	0.03	0.5	24.65	11.83	0.66	9.328	11.58	0.75	0.45	0.71	0.86	0.94	0.59	0.56
Slovakia	0.0105	0.0265	13.6610	13.3152	2.847.45	0.12	0.02	0.47	42.54	4.59	0.77	16.068	2.91	0.90	0.96	0.83	0.80	1.00	0.72	0.55
Slovenia	0.0106	0.0353	14.2154	13.2196	2.252.03	0.1	0.03	0.56	40.93	4.91	0.6	21.880	3.04	0.84	0.73	0.73	0.96	1.00	0.50	0.58
EU-10	**0.0142**	**0.044**	**13.66451**	**12.70668**	**3.050.59**	**0.13**	**0.04**	**0.53**	**41.55**	**7.19**	**0.67**	**14.292**	**5.52**	**0.85**	**0.81**	**0.78**	**0.86**	**0.98**	**0.62**	**0.57**

Note: Figures are sample means. lnP_1 (log) labour price, lnP_2 (log) financial capital price, lnY_1 (log) net loans in millions \$, lnY_2 (log) other earning assets in millions \$, TA: Total assets in millions \$, E/A: equity to assets ratio, LLP/L: loan loss provisions over total assets, L/A: loans to assets ratio, DCPS: domestic credit provided to the private sector as % of GDP, SPR: net interest spread, HHI: Herfindahl–Hirschman Index, GDPcppp: GDP per capita in purchasing power parity (PPP) constant 2005 \$, INFL: inflation rate, CR: composite credit regulations index, CR-Own: percentage of deposits held in privately owned banks, CR-Comp: foreign bank share of the domestic market, CR-PrS: extent of government borrowing relative to private sector borrowing with greater government borrowing resulting in lower ratings, CR-Nir: extent of interest rate controls with zero rating indicating government controlled nominal rates resulting in negative real rates, LR: composite labour regulation index, BR: composite business regulations index. Higher values of Indices denote a more liberal regulatory environment.
Source: Fitch-IBCA, Beck et al. (2000), World Bank, and Fraser Index of Economic Freedom.

Table 2: Summary Banking and Economic Reform Ratings CEE Countries (2004-2009)

Year	CR	CROwn	CRComp	CRPrS	CRnir	LR	BR
2004	0.82	0.8	0.77	0.85	0.99	0.62	0.59
2005	0.89	0.87	0.86	0.87	0.97	0.64	0.58
2006	0.89	0.88	0.86	0.86	0.98	0.65	0.57
2007	0.9	0.88	0.86	0.89	0.98	0.69	0.56
2008	0.9	0.87	0.86	0.88	0.98	0.69	0.56
2009	0.88	0.88	0.86	0.78	0.99	0.66	0.59
Total	**0.88**	**0.86**	**0.84**	**0.85**	**0.98**	**0.65**	**0.57**

Note: Figures are sample means and scaled to a 0-1 ratio. Higher values denote a more liberal regulatory environment. CR: composite credit regulations index, CR-Own: percentage of deposits held in privately owned banks, CR-Comp: foreign bank share of the domestic market, CR-PrS: extent of government borrowing relative to private sector borrowing with greater government borrowing resulting in lower ratings, CR-Nir: extent of interest rate controls with zero rating indicating government controlled nominal rates resulting in negative real rates, LR: composite labour regulation index, BR: composite business regulations index.
Source: The 2010 version of the Fraser Index of Economic Freedom.

Table 3: CEE Banking Sector Cost Efficiency (2004-2009)

	mean	Std. Dev.	Min	Max
BUL	0.7284379	0.1657638	0.2596304	0.9457929
CZS	0.8305003	0.1045656	0.424847	0.956909
EST	0.8365716	0.0824385	0.6193992	0.9438678
HUN	0.7643064	0.1831807	0.0439045	0.9684897
LAT	0.8251347	0.099439	0.3596099	0.9598934
LIT	0.8045001	0.1423296	0.3924884	0.9626565
POL	0.7809053	0.1408322	0.2381616	0.9663312
ROM	0.7809053	0.1408322	0.2381616	0.9663312
SLV	0.7377331	0.1535675	0.2665328	0.9266417
SLO	0.8861361	0.0436751	0.7458255	0.9643498
EFF2004	0.752177	0.182842	0.238162	0.966331
EFF2005	0.770741	0.131381	0.314497	0.941015
EFF2006	0.78595	0.127923	0.252684	0.950434
EFF2007	0.771899	0.148641	0.249643	0.960932
EFF2008	0.80823	0.136375	0.202692	0.96849
EFF2009	0.860191	0.059334	0.679478	0.948308

Note: Stochastic frontier efficiency scores per country (sample period statistics) and year (CEE wide statistics).

Table 4: Bank specific and financial structure determinants of efficiency (2004-2009)

Variables	Bank Specific	Financial Structure
ln(TA)	-0.0573928***	-0.018828**
	(0.005929)	(0.0095357)
E/A	0.7781396***	0.8735739***
	(0.0779144)	(0.0829741)
LLP/L	-0.0020933	0.0000198
	(0.0129759)	(0.0131967)
L/A	-0.148008***	-0.0485439
	(0.0414926)	(0.0472884)
SPR		0.0007956***
		(0.0005311)
lnGDPC		-0.2324928***
		(0.0532244)
INF		-0.0000155
		(0.0001041)
HH		0.0017264**
		(0.0008309)
Const.	1.024962***	2.55109***
	(0.0795239)	(0.4151959)
Obs.	1811	1646
R2	0.031	0.094
Number of Banks	268	268

Note: Fixed-effect panel estimation of bank efficiency with robust standard errors. TA: total assets; E/A: equity to assets ratio; LLP/L: loan loss provisions to loans ratio; L/A: loans to assets ratio; SPR: net interest spread, GDPC: GDP per capita in purchasing power parity (PPP) constant 2005 prices; INF: inflation rate; HH: Herfindahl–Hirschman Index. Country and time dummies included.

***, **, * indicate 1%, 5% and 10% significance levels respectively.

Table 5: Credit, Labour and Business Regulations (2004-2009)

Variables	Coeff.	Sdt. Err.
ln(TA)	-0.04732***	0.010532
E/A	0.699963***	0.104869
LLP/L	0.17504	0.150124
L/A	-0.07329	0.058745
DCPS	-0.12891*	0.044962
SPR	0.00186	0.003865
INF	0.004534***	0.001433
CR	-0.05648***	0.011694
LR	0.030019***	0.010603
BR	0.0287***	0.010989
Const.	1.003212***	0.148299
Observations	1153	
R-squared	0.1020	
Number of banks	268	

Note: Fixed-effects panel estimation of bank efficiency with robust standard errors. TA: total assets; E/A: equity to assets ratio; LLP/L: loan loss provisions to loans ratio; L/A: loans to assets ratio; DCPS: domestic credit provided to the private sector as % of GDP, SPR: net interest spread; INF: inflation rate; CR: credit regulation; LR: labor market regulation; BR: business regulations. Country and time dummies included.
***, **, * indicate 1%, 5% and 10% significance levels respectively.

Table 6: The impact of the Fraser sub-components of the Credit Regulation index on cost efficiency (2004-2009)

Note: Fixed-effects panel estimation of bank efficiency with robust standard errors. TA: total assets; E/A: equity to assets ratio; LLP/L: loan loss provisions to loans ratio; L/A: loans to assets ratio; DCPS: domestic credit provided to the private sector as % of GDP, SPR: net interest spread; INF: inflation rate; CR-Comp: foreign bank share of the domestic market, CR-PrS: extent of government borrowing relative to private sector borrowing with greater government borrowing resulting in lower ratings, CR-Nir: extent of interest rate controls with zero rating indicating government controlled nominal rates resulting in negative real rates. Country and time dummies included.
***, **, * indicate 1%, 5% and 10% significance levels respectively.

Variables	**CR-Comp**	**CR-PrS**	**CR-Nir**	**All types of Credit Regulations**
ln(TA)	-0.05635***	-0.0523***	-0.05496***	-0.05329***
	(0.009914)	(0.009419)	(0.009471)	(0.009902)
E/A	0.714601***	0.720123***	0.725392***	0.728003***
	(0.106403)	(0.105628)	(0.107335)	(0.106659)
LLP/L	0.228807	0.190993	0.223051	0.192248
	(0.152183)	(0.151153)	(0.151988)	(0.151528)
L/A	-0.1002*	-0.09498	-0.09305	-0.09366
	(0.058957)	(0.058223)	(0.058868)	(0.058792)
DCPS	-0.13766***	-0.12456*	-0.1257***	-0.12111***
	(0.045257)	(0.044271)	(0.045639)	(0.046086)
SPR	-0.00172	0.0002	-0.00071	0.000729
	(0.003874)	(0.003862)	(0.004022)	(0.004032)
INF	0.005495***	0.004159***	0.005478***	0.004084***
	(0.001444)	(0.001479)	(0.001444)	(0.001486)
CR-Comp	0.002555			0.011795
	(0.004585)			(0.045736)
CR-PrS		-0.25958***		-0.25587***
		(0.070914)		(0.071353)
CR-Nir			0.011607	0.08758
			(0.015521)	(0.154482)
Constant	1.004942***	1.182977***	0.877116	1.093027***
	(0.132699)	(0.1405)	(0.208082)	(0.215147)
Observations	1153	1153	1153	1153
R-squared	0.0632	0.0922	0.0661	0.0995
Number of banks	268	268	268	268

Table 7: The impact of EBRD reform indexes on cost efficiency (2004-2009)

Variables	EBRD index market sector reform	EBRD index financial sector reform	EBRD index securities markets sector reform	EBRD all indexes reforms
ln(TA)	0.025251***	-0.03525***	0.022257***	-0.03574***
	(0.007236)	(0.00854)	(0.007258)	(0.008622)
E/A	0.571029***	0.894959***	0.572929***	0.894526***
	(0.121197)	(0.08282)	(0.119903)	(0.08297)
LLP/L	0.228886	0.141677***	0.223256**	0.140699***
	(0.104243)	(0.048741)	(0.103213)	(0.048741)
L/A	0.007815	-0.05364	-0.00232	-0.0564
	(0.059831)	(0.046662)	(0.05936)	(0.046695)
DCPS	-0.15638**	-0.10704***	-0.15745**	-0.11125***
	(0.06736)	(0.039241)	(0.066586)	(0.039432)
SPR	0.001938**	0.001344**	0,001882**	0.001391*
	(0.000797)	(0.000536)	(0.000789)	(0.000536)
INF	0.000429	0.0001344	0.000495	-0.00017
	(0.000405)	(0.000108)	(0.000402)	(0.000108)
Compebrd	0.038479			-0.01326
	(0.0264)			(0.020097)
Bankebrd		0.001344		-0.05923***
		(0.016876)		(0.022341)
Secebrd			0.057386	0.034655
			(0.019458)	(0.022533)
Constant	-0.21332*	0.001344***	-0.22583*	0.8367***
	(0.128921)	(0.115145)	(0.115955)	(0.116112)
Observations	1545	1545	1545	1545
R-squared	0.1499	0.0720	0.1525	0.0770
Number of banks	268	268	268	268

Note: Fixed effects panel estimation of bank efficiency with robust standards errors covering three aspects of transition (EBRD 2010): markets (competition policy) (Compebrd); banking reform and interest rate liberalization (Bankebrd); and securities markets and non-bank financial institutions (Secebrd)); TA: Total assets; E/A: equity to assets ratio; LLP/L: loan loss provisions to total assets ratio; L/A: loans to assets ratio; DCPS: domestic credit provided to the private sector as % of GDP, SPR: net interest spread. Country and time dummies included.

***, **, * indicate 1%, 5% and 10% significance levels respectively.

Table 8: The impact of Frazer and EBRD indexes: dynamic panel analysis (2004-2009)

Variables	Frazer Reforms Indicators	EBRD reforms indicators
EFFL1	0.322937***	0.3693802***
	(0.0437087)	(0.088008)
ln(TA)	-0.083277***	-0.042332***
	(0.011864)	(0.0150913)
E/A	0.6871281***	0.7956339***
	(0.1959127)	(0.2584948)
LLP/L	-0.0794308	0.1127762
	(0.261147)	(0.1476063)
L/A	-0.0463453	0.1294313
	(0.0933141)	(0.1164492)
SPR	-0.0114306	-0.0024578
	(0.0047218)	(0.0057406)
DCPS	-0.0013112**	-0.0243268
	(0.0005211)	(0.0427321)
CR	-0.0203268	
	(0.0184892)	
LR	0.0597526**	
	(0.0144661)	
BR	0.0570376**	
	(0.0134679)	
Compebrd		0.0387171*
		(0.022931)
Bankebrd		0.0346008
		(0.0311009)
Secebrd		-0.0189348
		(0.0373422)
Constant	0.8620816***	0.4336765
	(0.2228869)	(0.2862306)
Observations	867	1100
Number of banks	268	268

Wald-test	339.97	101.37
P-values	0.000	0.000
AR1	0.016	0.025
AR2	0.485	0.564
Sargan	0.242	0.419

Note: Dynamic panel estimation of bank efficiency on Frazer and EBRD reform indexes covering Credit Regulation (CR), Labour Regulation (LR) and Business Regulation (BR) and three broad aspects of transition (EBRD 2010): competition policy (Compebrd); banking reform and interest rate liberalization (Bankebrd) and securities markets and non-bank financial institutions (Secebrd) with robust standards errors. DCPS: domestic credit provided to the private sector as % of GDP, SPR: net interest spread. EFFL1: lagged efficiency. Wald tests the overall significance of the models, AR1 and AR2 are p-values of tests for autocorrelation in first differences and levels, and Sargan is the p-value for the Sargan test on the validity of over-identifying restrictions (i.e. testing whether the instruments as a group are exogenous). Country and time dummies included. ***, **, * indicate 1%, 5% and 10% significance levels respectively.

Table 9: Variance Decompositions

Panel A: Variance Decompositions (VDCs) for EFF, CR, LR, and BR

	s	EFF	CR	LR	BR
EFF	10	0.798845	0.123555	0.072614	0.004987
CR	10	0.175733	0.730508	0.014005	0.079754
LR	10	0.069547	0.092056	0.678403	0.159995
BR	10	0.165086	0.254625	0.1313	0.448989
EFF	20	0.798818	0.123573	0.072622	0.004987
CR	20	0.175795	0.73038	0.014088	0.079736
LR	20	0.069653	0.092103	0.678288	0.159956
BR	20	0.165086	0.254626	0.1313	0.448988

Panel B: Variance Decompositions (VDCs) for EFF, Compebrd, Bankebrd, and Secebrd

	s	EFF	Compebrd	Bankebrd	Secebrd
EFF	10	0.7318	0.101249	0.150085	0.016866
Compebrd	10	0.036759	0.754276	0.196972	0.011992
Bankebrd	10	0.006039	0.032935	0.88633	0.074696
Secebrd	10	0.007244	0.129355	0.191001	0.6724
EFF	20	0.731131	0.101174	0.150067	0.017628
Compebrd	20	0.036776	0.754006	0.196931	0.012287
Bankebrd	20	0.006056	0.032957	0.886096	0.074891
Secebrd	20	0.007313	0.129252	0.190987	0.672448

Note: s defines the periods ahead of VDCs. EFF: efficiency; CR: composite credit regulation index, LR: composite labour regulation index, BR: composite business regulations index, Compebrd, competition policy, Bankebrd: banking reform and interest rate liberalization, and Secebrd: securities markets and non-bank financial institutions.

Table A1: The components of the Fraser index of economic freedom used in the study

Variable	Category	Nature	Description
CR-Own	Credit Regulations	Component	Data on the percentage of bank deposits held in privately owned banks were used to construct rating intervals. Countries with larger shares of privately held deposits received higher ratings. When privately held deposits totalled between 95% and 100%, countries were given a rating of 10. When private deposits constituted between 75% and 95% of the total, a rating of 8 was assigned. When private deposits were between 40% and 75% of the total, the rating was 5. When private deposits totalled between 10% and 40%, countries received a rating of 2. A zero rating was assigned when private deposits were 10% or less of the total.
CR-Comp	Credit Regulations	Component	If a country approved all or most foreign bank applications and if foreign banks had a large share of the banking sector assets, then the country received a higher rating
CR-PrS	Credit Regulations	Component	This sub-component measures the extent to which government borrowing crowds out private borrowing. When data are available, this sub-component is calculated as the government fiscal deficit as a share of gross saving. Since the deficit is expressed as a negative value, higher numerical values result in higher ratings. The formula used to derive the country ratings for this sub-component was (−Vmax − Vi) / (Vmax + Vmin) multiplied by 10. Vi is the deficit to gross investment ratio, and the values for Vmax and Vmin are set at 0 and −100.0%, respectively. The formula allocates higher ratings as the deficit gets smaller (i.e., closer to zero) relative to gross saving. If the deficit data are not available, the component is instead based on the share of private credit to total credit extended in the banking sector. Higher values are indicative of greater economic freedom. Thus, the formula used to derive the country ratings for this sub-component was (Vi − Vmin) / (Vmax − Vmin) multiplied by 10. Vi is the share of the country's total domestic credit allocated to the private sector and the values for Vmax and Vmin are set at 99.9% and 10.0%, respectively. The 1990 data were used to derive the maximum and minimum values for this component. The formula allocates higher ratings as the share of credit extended to the private sector increases.
CR-NiR	Credit Regulations	Component	Data on credit-market controls and regulations were used to construct rating intervals. Countries with interest rates determined by the market, stable monetary policy, and positive real deposit and lending rates received higher ratings. When interest rates were determined primarily by market forces and the real rates were positive, countries were given a rating of 10. When interest rates were primarily market determined but the real rates were sometimes slightly negative (less than 5%) or the differential between the deposit and lending rates was large (8% or more), countries received a rating of 8. When the real deposit or lending rate was persistently negative by a single-digit amount or the differential between them was regulated by the government, countries were rated at 6. When the deposit and lending rates were fixed by the government and the real rates were often negative by single-digit amounts, countries were assigned a rating of 4. When the real deposit or lending rate was persistently negative by a double-digit amount, countries received a rating of 2. A zero rating was assigned when the deposit and lending rates were fixed by the government and real rates were persistently negative by double-digit amounts or hyperinflation had virtually eliminated the credit market.
CR	Credit Regulations	Composite	Composite index of the above

LR	Labour Regulations	Composite	A measure of the extent to which labour market rigidities are present. In order to earn high marks in the LR component, a country must allow market forces to determine wages and establish the conditions of hiring and firing, and refrain from the use of conscription.
BR	Business Regulations	Composite	The variable aims to identify the extent to which regulations and bureaucratic procedures restrain entry and reduce competition. In order to score high in this part of the index, countries must allow markets to determine prices and refrain from regulatory activities that retard entry into business and increase the cost of producing products. They also must refrain from using their power to extract financial payments and reward some businesses at the expense of others.

Note: The table reports only the components of the Fraser index of economic freedom used in this study. The index consists of five areas: (1) size of government; (2) legal structure and security of property rights; (3) access to sound money; (4) freedom to exchange with foreigners; and (5) regulation of credit, labour, and business. For the overall index as well as its components and its subcomponents a score of 0 indicates the lowest and a score of 10 the highest economic freedom (less regulatory restrictions). Source: The 2010 version of the Fraser index of Economic Freedom.

Table A2: The components of the EBRD indicators used in the study

Variable	Category	Nature	Description
Compebrd	Markets and Trade	Component	The scores range from 1 where most prices formally controlled by the government, to 4+ where are standards and performance typical of advanced industrial economies: effective enforcement of competition policy; unrestricted entry to most markets
Bankebrd	Financial institutions	Component	Banking reform and interest rate liberalisation. The scores range from 1 where there is little progress beyond establishment of a two-tier system, to 4+ for countries with standards and performance norms of advanced industrial economies: full convergence of banking laws and regulations with BIS standards; provision of full set of competitive banking services.
Secebrd	Financial institutions	Component	Concerns Securities markets and non-bank financial institutions. The scores range from 1 where. little progress is made in this sector, to 4+ for countries Standards and performance norms of advanced industrial economies: full convergence of securities laws and regulations with IOSCO standards; fully developed non-bank intermediation.

Note: The table reports only the components of the EBRD indicators used in this study. The EBRD transition indicators consist of four areas: (1) Enterprises; (2) Markets and trade; (3) Financial institutions; (4) infrastructure. Source: The 2010 version of the EBRD Transition Report.

Table A3: Alternative Estimations of AR(1) Specification for Bank Efficiency

Variables	GMM	Within Groups	OLS Levels
EFFL1	0.322***	0.154***	0.456***
	(0.0437087)	(0.07514)	(0.070930)
Observations	867	867	867
Number of banks	268	268	268
AR1	0.016	0.025	0.011
AR2	0.485	0.256	0.746
Sargan	0.242	0.283	0.481

Note: Dynamic panel estimation of bank efficiency on Frazer and EBRD reform indexes covering Credit Regulation (CR), Labour Regulation (LR) and Business Regulation (BR) and three broad aspects of transition (EBRD 2010): competition policy (Compebrd); banking reform and interest rate liberalization (Bankebrd) and securities markets and non-bank financial institutions (Secebrd) with robust standards errors. DCPS: domestic credit provided to the private sector as % of GDP, SPR: net interest spread. EFFL1: lagged efficiency. Wald tests the overall significance of the models, AR1 and AR2 are p-values of tests for autocorrelation in first differences and levels, and Sargan is the p-value for the Sargan test on the validity of over-identifying restrictions (i.e. testing whether the instruments as a group are exogenous). Country and time dummies included. ***, **, * indicate 1%, 5% and 10% significance levels respectively.

Notes

[1] In the literature prior studies consider either the EBRD index of banking sector reform (e.g. Fries and Taci 2005, Koutsomanoli-Filippaki et al. 2009, Brissimis et al. 2008, Koutsomanoli-Filippaki et al. 2009a, Koutsomanoli-Filippaki et al. 2009b, Delis et al. 2011) or the Fraser Index of Economic Freedom (Mamatzakis et al. 2013) but not both.

[2] According to Lagoarde-Segot (2016) and Buchanan (2016), Aalbers, (2015) defines financialization as "the increasing dominance of financial actors, markets, practices, measurements and narratives at various scales, resulting in a structural transformation of economies, firms (including financial institutions), states and households".

[3] See for instance the papers of Lagoarde-Sagot (2015), Buchanan (2016) and Sokol (2015) for a discussion on the concept of financialization.

[4] Following Barth et al. (2013) bank regulations and supervisory practices comprise a wide range of activities, such as capital regulation, entry regulations, activities restrictions, supervisory power and independence, external governance and private-sector monitoring.

[5]We recognise the potential bias problem in the two step estimator but the main argument of opting for a two-step procedure is because we focus on the impact of a plethora of indexes such as Fraser and EBRD, and their sub-indexes, on efficiency, in addition to various other control variables. Including all variables in one stage would restrict attention to modeling heterogeneity in the error term of the SFA model rather than focusing on a more explicit specification of the underlying sources of inefficiency. There is also a practical consideration at stake, namely the likelihood function of the heterogeneous model often appears to be ill conditioned. Hence we have opted for the traditional two step procedure, which is common practice in the literature when there are many control variables, or second stage variables such as ours herein (see Koutsomanoli-Filippaki et al. 2009, Kasman and Yildirim 2006, among others).

[6]For simplification, we omit the time subscript (*t*).

[7]The treatment of physical capital as a fixed input is relatively standard in efficiency estimation (Berger and Mester, 1997), while the level of equity captures capitalization, insolvency risk and different risk preferences across banks (Berger and Mester 1997).

[8] Time trends (t) are included to capture the effects of technical progress with interaction terms with other regressors added to capture the effects of non-neutral technical change.

[9]Due to the time dimension of the data series we test for the existence of panel unit roots in the underlying data using standard tests such as: Levin-Lin-Chu, Harris-Tzavalis, and Im-Pesaran-Shin. All tests show that our bank specific variables within the cost function framework of equation (2) appear to be stationary processes.

[10]For a detailed review of the reform process see EBRD Transition Report (2010).

[11]We believe that combining different indexes such as the Fraser index and the EBRD indicators, and taking into account financial and non-financial transition indicators give us a more complete picture of the environment in which banks operate in the CEE countries.

[12]There are several studies that examine the impact of credit/financial reforms at an aggregate level on bank efficiency in transition countries (Fries et al. 2006, Koutsomanoli-Filippaki et al., 2009, Delis and Papanikolaou, 2009 and Delis et al. 2011). An exception is the study of Mamatzakis et al. (2013) who consider the decomposition of credit regulation.

[13]The CR-Own index was dropped from our analysis since it was consistently insignificant.

[14] We have also estimated the dynamic panel with OLS and the Within estimator. The former is known to yield an estimate of the lagged dependent variable coefficient which is upwards biased while the latter yields a downwards biased estimate with the magnitude of the bias dependent on the degree of persistence in the series. The GMM estimate which may also be biased is usually between these two. We report the estimation results in table A3 in the Appendix.

[15]For robustness related reasons, we estimate both the static fixed effects model and the dynamic panel model without including the period of the financial meltdown. Results remain similar to the ones reported herein (available under request).

[16]Optimal lag order of one is based on the Akaike Information Criterion (AIC), confirmed by Arellano-Bond AR tests.

[17]The results do not show violation of the normality assumption. Panel VAR results are available under request.

[18]Low estimated covariances between the errors across equations would also be another indication that the ordering is not an issue. Our results show that estimated error covariances are indeed very low.

[19]For instance, financial development is a source of growth; at the same time it must be accompanied by macroeconomic reforms, and regulation. In other words, successful transition in the business sector is mainly about removing the role of the state and encouraging private ownership and market forces wherever possible. However, markets cannot function properly unless there are well-run and effective public institutions in place in order to enforce rules and ensure fair competition (EBRD 2010).